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1 WINGED PLOW

BACKGROUND OF THE INVENTION

 The present invention relates to winged plow
assemblies for use with a vehicle.

5 Straight blade plows cantilevered from an end of a
plow vehicle are commonly found in those geographic regions
where winter snow accumulation must be cleared from a
surface, such as streets, parking lots, and walkways for
example, so that people may travel about their daily
10 business without undue hazard from deep snow. During the
plowing operation, a plow may be operated either in a
centered position, being generally square with the vehicle
and generally perpendicular to the vehicle motion, or in an
angled position in which the plow is directed toward one
15 side or the other at an angle to the vehicle motion. When
plowing with the plow centered, snow will accumulate in
front of the plow and typically spill over the ends of the
plow. Thus, in the interest of increased plowing
efficiency, plow operators are known to fix plates at the
20 ends of the plow blade to minimize such spill over and
retain the snow in front of the blade to effectively
increase the plow capacity. However, while these additional
plates enhance straight line plowing, they are equally
detrimental to angled plowing because the plates then
25 effectively clog the blade surface with accumulated snow,
thwarting the objective of casting snow to the side during
angled plowing.

 Accordingly, a need has been recognized for plows
to enable either angled or straight/centered plowing, and to
30 increase the efficiency of the plow in the centered position
by preventing spill over from the plow ends while allowing



2090992

- 1 proper material flow along the plow blade during angled
plowing.

SUMMARY OF THE INVENTION

The present invention addresses the

- 5 above-described need with a winged plow assembly which
enhances both centered and angled plowing. The winged plow
assembly includes a support frame pivotally connected with
the plow vehicle. An elongated plow blade is pivotally
10 connected with the support frame for generally horizontal
rotation of the plow blade between centered and angled
positions. A pair of plow blade wings are pivotally
connected with the plow blade, one wing being located at
each of two opposing ends of the plow blade. The wings
rotate between a closed position wherein the wings project
15 generally forward from the plow blade, the wings and blade
defining a generally U-shaped assembly in the closed
position so that the wings facilitate pushing material with
the plow, and an open position in which the wings project in
generally opposite directions away from each other and
20 effectively extend the length of the plow blade so that the
wings facilitate moving material to the side of the plow.
An actuator automatically rotates the wings between the
closed position when the plow blade is in a centered
position, generally perpendicular to a longitudinal
35 centerline of the plow vehicle, and the open position when
the plow blade is rotated substantially away from the
centered position to an angled position.

- In one aspect of the invention, the actuator
interconnects the wings with the support frame. The wings
30 may also be biased to the closed position and the actuator
may further include a cable connected with each wing and the

2090992

1 support frame for pulling the wings into the open position
when the plow blade is rotated substantially away from the
centered position.

5 The actuator may also include a latch for latching
the wings in the closed position. The latch may be adapted
to release the wings from the closed position for rotation
to the open position when the plow blade is rotated
substantially away from the centered position.

10 In an alternative aspect of the invention, the
actuator may include a mechanical power source
interconnected between at least one wing and the plow blade.
The actuator may also include a control for the mechanical
power source which is adapted for sensing the position of
15 the plow blade relative to the support frame for sending an
open signal to the mechanical power source when the plow
blade is rotated substantially away from the centered
position. Further, the mechanical power source may be a
hydraulic cylinder.

20 Alternatively, a mechanical linkage may be
connected between the support frame and plow to open and
close the plow wings as the plow is pivoted horizontally
between centered and angled positions.

25 In another aspect of the invention, the plow blade
may also be pivotally connected with the support frame not
only for horizontal rotation, but also for rotation about a
generally horizontal axis between a normally generally
vertical position and a generally horizontal, trip position
when a bottom edge of the plow blade engages a protrusion
from a surface to be cleared. The blade may be biased to
30 the normally vertical position. Further, the cabling of the
actuator may extend along the plow blade from each wing to

2090992

1 the support frame and be positioned adjacent the horizontal
axis of rotation of the plow blade.

In yet another aspect of the invention, horizontal
rotation of the plow blade may be provided by a power
5 rotation device. The power rotation device may include a
pair of hydraulic cylinders positioned so that one cylinder
extends between the plow blade and each one of two opposing
sides of the support frame.

Accordingly, the present invention provides a plow
10 with a pivotable wing at each of two opposing ends of a plow
blade and an actuator for rotating the wings between a
closed position when the plow blade is in a centered
position and an open position when the plow blade is rotated
substantially away from the centered position to an angled
15 position. Thus, straight-ahead plowing with the plow blade
in a generally centered position is enhanced by closed wings
on the ends of the plow blade to resist spill over of
material around the ends of the plow blade, capturing more
material in front of the plow blade to thereby increase the
20 straight-ahead plowing efficiency. Further, angled plowing
is accommodated and made more efficient since the wings
rotate to an open position when the plow blade is rotated
substantially away from the centered position. The plowed
material is thereby cast off to the side of the plow path at
25 the trailing end of the plow blade, rather than being
captured by a closed trailing wing and clogging the plow
blade with the captured material. Angled plowing efficiency
is also enhanced since the open wings effectively extend the
length of the plow blade and the plowed width is not
30 diminished by rotating the plow blade substantially away
from the centered position.

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1 These and other objects, advantages, purposes and
features of the invention will become more apparent from a
study of the following description taken in conjunction with
the drawings.

5 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a first embodiment
of a winged plow assembly according to the present
invention;

10 Fig. 2 is an exploded top plan view of the plow
assembly of Fig. 1;

Fig. 3 is a right side elevational view of the
plow assembly of Fig. 1, showing in phantom, rotation of the
plow blade about a horizontal axis to a tripped position;

15 Fig. 4 is a right end elevational view of the plow
blade of Fig. 1 with the wing removed;

Fig. 5 is a right side elevational view of the
plow carrier of Fig. 1;

Fig. 6 is an outside elevational view of the left
wing;

20 Fig. 7 is a fragmentary perspective view of the
left end of the plow blade of Fig. 1;

Fig. 8 is a partial fragmentary top plan view of
the plow assembly of Fig. 1 in a centered position, with the
wings closed;

25 Fig. 9 is a fragmentary rear elevational view of
the right end of the plow blade of Fig. 1 taken along line
IX-IX of Fig. 8;

Fig. 10 is a top plan view of a latch arm of the
plow assembly of Fig. 1;

30 Fig. 11 is an end elevational view of the latch
arm as indicated by sight lines XI-XI in Fig. 10;

2090992

1 Fig. 12 is a partial fragmentary top plan view of
the plow assembly of Fig. 1 with the plow blade in a
slightly off center, angled position;

5 Fig. 13 is a top plan view detail of a latch block
of the plow assembly as indicated by sight lines XIII-XIII
in Fig. 9;

 Fig. 14 is a rear elevational view of the latch
block of Fig. 13 as indicated by sight lines XIV-XIV in Fig.
13;

10 Fig. 15 is an end elevational view of the latch
block as indicated by sight lines XV-XV in Fig. 14;

 Fig. 16 is a partial fragmentary top plan view of
the plow assembly of Fig. 1 with the plow blade rotated
substantially off center to a fully angled position and the
15 wings open;

 Fig. 17 is a schematic drawing of a hydraulic
cylinder rotating device for use with the plow assemblies of
the present invention using a spool valve with single acting
cylinders;

20 Fig. 18 is a schematic drawing of an alternative
embodiment of the hydraulic cylinder rotating device using a
spool valve with double acting cylinders;

 Fig. 19 is a schematic drawing of a second
alternative embodiment of the hydraulic cylinder rotating
25 device using poppet valves with single acting cylinders;

 Fig. 20 is an outside elevational view of an
alternative embodiment of the right plow wing;

 Fig. 21 is a fragmentary rear elevational view of
the left end of a second embodiment of the plow blade
30 showing an alternative embodiment of the actuator;

2090992

1 Fig. 22 is a partial schematic top plan view of a
second embodiment of the plow assembly showing an
alternative embodiment of the actuator;

5 Fig. 23 is a schematic detail of the limit
switches of Fig. 22;

 Fig. 24 is the schematic detail of Fig. 23 with
the plow blade rotated off-center to the left;

 Fig. 25 is the schematic detail of Fig. 24 with
the plow blade rotated off-center to the right;

10 Fig. 26 is a top plan view of a third embodiment
of the plow assembly showing a second alternative embodiment
of the actuator;

15 Fig. 27 is the top plan view of the plow assembly
of Fig. 26 with the plow blade rotated substantially
off-center to the right and the wings open;

 Fig. 28 is a partial elevational view, shown
partly in section, taken along section line XXVIII-XXVIII of
Fig. 26 with the plow blade removed;

20 Fig. 29 is a partial elevational view, shown
partly in section, taken along section line XXIX-XXIX of
Fig. 26 with the plow blade removed;

 Fig. 30 is a rear perspective view of the second
alternative embodiment of the actuator;

25 Fig. 31 is a top plan view of the plow carrier and
second alternative embodiment of the actuator; and

 Fig. 32 is a top plan view of the plow carrier
with the second alternative embodiment of the actuator and a
fragment of the support frame.

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2090992

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings in greater detail, Figure 1 shows a winged plow assembly 30 according to the present invention including a support frame 32, a plow carrier 34, a plow blade 36, a pair of blade wings 38 and 40, and an actuator which will be described in greater detail below.

Support frame 32 may be any of the commonly known vehicle mounted plow support frames, commonly referred to as a T- or A-frame, and pivotally connected with the plow vehicle for movement about a generally horizontal axis to raise and lower the entire plow assembly. One of the various commonly known pivot connections between the vehicle and support frame 32 includes a number of pivot plates 42 projecting rearwardly from a cross member 44 (Figs. 1, 2, and 3). Pivot plates 42 are adapted to receive a pivot pin 46 and to couple with cooperating pivot members (not shown) on the plow vehicle. Pivot plates 42 couple with the pivot members and pivot pin 46 interconnects the pivot plates with the pivot members in a hinge-like manner. As is best seen in Figure 2, longitudinal frame member 48 extends forward from cross member 44 to a terminal end 50 and has a generally vertically oriented pivot pin aperture 52 extending through longitudinal frame member 48 near terminal end 50.

Plow carrier 34 has a generally triangular upper frame 54 and a generally trapezoidal lower frame 56 (Figs. 2 and 3). Each of the upper and lower frames 54, 56 extend rearwardly from opposing top and bottom sides, respectively, of a transverse carrier member 58 (Figs. 2 and 3). Transverse carrier member 58 has a pair of vertically

2090992

1 aligned pin apertures 60 and is adapted to receive terminal
end 80 of longitudinal frame member 48 in pivoting
engagement. Transverse carrier member 58 and longitudinal
frame member 48 are interconnected with a pivot pin or bolt
5 62 (Figs. 5 and 8).

Transverse carrier member 58 has opposing left 64
and right 66 ends (Figs. 2 and 5). Upper frame members 68
and 70 extend rearwardly and generally inwardly toward each
other from opposing ends 64 and 66 of transverse carrier
member 58 and terminate by connection with a slide plate 72,
10 forming triangular upper frame 54. Slide plate 72 is
captured in sliding engagement under a hook 74 which
projects upward from a top surface of longitudinal frame
member 48 (Fig. 3). Hook 74 thus restrains plow blade 36
15 and plow carrier 34 from pivoting vertically downwardly
about pivot pin 62 and the end of frame member 48.

Lower frame member 56 may be a single, generally
trapezoidal-shaped plate, extending generally rearward from
transverse carrier member 58 (Figs. 2 and 5). Cable sheaves
20 or guides, but most preferably pulleys 76, are rotatably
mounted under and at each corner of lower frame member 56
(Figs. 2 and 5).

A power rotation device is preferably provided for
horizontally rotating plow carrier 34, and plow blade 36
when mounted thereon, relative to support frame 32. This
25 rotation device may be implemented in a number of ways, but
preferably includes a pair of hydraulic cylinders 78 and 80
(Fig. 2). Various commonly available hydraulic cylinders
may be used and cylinders having a 1.5 inch (3.80 cm) rod
and a 9.83 inch (25 cm) stroke have been found to perform
30 satisfactorily. One of cylinders 78 and 80 is positioned on

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1 each of two opposing sides of a subassembly formed by plow
carrier 34 being rotatably mounted to support frame 32 as
described above.

5 Cylinder 78 is preferably mounted with its head
and pivotally connected at a left end 83 of support frame
cross member 44 (Fig. 2). The opposing rod end of cylinder
78 is pivotally connected with transverse carrier member 58
at a location 79 about midway between terminal end 50 of
longitudinal frame member 48 and left end 64 of transverse
10 carrier member 58. Cylinder 80 is likewise pivotally
connected between a right end 84 of frame cross member 44
and a location 81 along transverse carrier member 58, about
midway between longitudinal frame member 48 and right end 66
of transverse carrier member 58.

15 As shown in Figures 17-19, various common
hydraulic power systems may be used with the hydraulic
cylinders 78, 80. Each hydraulic power system includes a
hydraulic fluid reservoir 86, power pump 88, control valving
90, and interconnecting hydraulic lines, including a return
20 line 92 to the reservoir. Each of these hydraulic power
systems further includes commonly known pressure relief
valves 93 in the hydraulic fluid circuit as is commonly
known.

25 Figure 17 shows a system incorporating single
acting cylinders 78 and 80 and a spool valve 94. Spool
valve 94 may be any of various control valves commonly
available, including a Green V20 open center directional
control valve having three-position, four-way solenoid
operation with the spool blocked in neutral and both port
30 and main reliefs for example. As described in greater
detail below, regarding Figure 23, an operator may select

2090992

1 left or right rotation of plow blade 36 to a desired angled
position. In the arrangement of Figure 17, if the operator
selects a left rotation of blade 36, spool valve 94 directs
hydraulic fluid from pump 88 to the head end of single
5 acting cylinder 80 to extend the rod of cylinder 80. While
plow blade 36 thusly rotates to the left, single-acting
cylinder 78 is compressed by this rotation and hydraulic
fluid is pressed out of cylinder 78, through control valve
94 and return line 92 to reservoir 86. Conversely, if the
10 operator selects a rotation of plow blade 36 to the right,
control valve 94 directs hydraulic fluid to the head end of
cylinder 78 to extend the rod of cylinder 78, rotating plow
blade 36 and compressing cylinder 80, which expels hydraulic
fluid through control valve 94 and return line 92 to
15 reservoir 86.

Figure 18 shows a system incorporating the same
spool valve 94 as in Figure 17, but used with double-acting
cylinders 78a and 80a. In this arrangement, when the
operator selects a rotation of plow blade 36 to the left,
20 control valve 94 directs hydraulic fluid to the head end of
cylinder 80a and rod end of cylinder 78a. Thus, while the
rod of cylinder 80a is extended, the rod of cylinder 78a is
retracted, not merely compressed in contrast to the system
of Figure 17, and cylinder 78a pulls plow blade 36 while
25 cylinder 80a pushes plow blade 36, both in a left-hand
rotation of plow blade 36. While the rod of cylinder 80a
extends and the rod of cylinder 78a retracts, fluid is
expelled from the rod end of cylinder 80a and from the head
end of cylinder 78a. The expelled fluid flows through
30 control valve 94 and return line 92 to reservoir 86.
Selection of a right-hand rotation by the operator

2090992

1 substantially reverses this function with control valve 94
directing fluid to the head end of cylinder 78a and the rod
end of cylinder 80a. Fluid is then expelled from the rod
end of cylinder 78a and the head end of cylinder 80a, flows
5 through control valve 94, and return line 92 to reservoir
86.

Figure 19 shows a system incorporating the same
single-acting cylinders 78 and 80 as in Figure 17, but used
with control valving having commonly known poppet valves
10 96a-d. When an operator selects a left rotation in this
arrangement, poppet valves 96a and 96c are opened. Fluid is
directed to the head end of cylinder 80 through valve 96c
from pump 88. As with the system of Figure 17, while the
rod of cylinder 80 extends, the rotation of plow blade 36
15 compresses the rod of cylinder 78 and expels fluid from
cylinder 78 which flows through valve 96a and return line 92
to reservoir 86. Conversely, the operator may select a
right rotation of plow blade 36, opening poppet valves 96b
and 96d to direct fluid to the head end of cylinder 78
20 through valve 96b. While the rod of cylinder 78 extends and
plow blade 36 rotates to the right, the rod of cylinder 80
is compressed, expelling fluid through valve 96d and return
line 92 to reservoir 86.

In each of the systems shown in Figures 17-19,
25 hydraulic power pump 88 is typically not continuously
energized and preferably only runs when actually required
for hydraulic power to move plow blade 36. This minimizes
the amount of power drawn from the plow vehicle.

As shown in Figure 2, a second set of parallel
10 pivot plates 100 project forward from transverse carrier
member 58 and are adapted for coupling with pivot members

2090992

1 102 provided on plow blade 36. Pivot plates 100 and pivot
members 102 are adapted to receive coaxial pivot pins or
bolts (not shown) which interconnect pivot plates 100 with
pivot members 102 in a hinge-like manner along a common,
5 generally horizontal pivot axis or "trip" axis 104 (Figs. 3
and 8).

Plow blade 36 and plow carrier 34 are thus
pivotally interconnected for generally horizontal rotation
of the plow blade and rotation of the plow blade about
10 horizontal trip axis 104, between a generally vertical or
normal plowing position and a generally horizontal or
tripped position, shown in phantom in Figure 3. During many
plowing conditions, the lower edge of the plow blade may
encounter a protrusion from a surface to be cleared, such as
15 a parking stop, curb, or uneven cement joint for example.
This tripping rotation about trip axis 104 allows the blade
to rotate forward and present an inclined surface to the
protrusion so that in conjunction with the pivotal
connection of support frame 32 with the plow vehicle, plow
20 blade 36 will "ramp" up and over the protrusion, rather than
remain in the generally vertical position. If, however,
plow blade 36 were not allowed to trip, a significant force
may be imparted to the blade through the protrusion and
damage to plow assembly 30 or the plow vehicle may result.

25 Plow blade 36 is biased toward the normally,
generally vertical position by trip or bias springs 105
which interconnect between plow carrier 34 and the blade,
near the top of the blade (Figs. 2, 3, and 8). At one end
of each trip spring 105, the springs hook through apertures
30 provided in spring plates 106 which extend generally
vertically upwardly from transverse carrier member 38 (Fig.

2090992

1 3). At an opposing end of each trip spring 105, the springs
hook through the eye of an eye bolt 106 which in turn
extends through an aperture provided in a plate 110 which
projects rearwardly from plow blade 36, near the top of the
5 blade (Figs. 2 and 3). The interconnection of trip springs
105 with plow blade 36 through eye bolts 106 allows
pretension adjustment of the springs to vary the biasing
force exerted by the springs.

Blade wings 38 and 40 are pivotally connected with
10 plow blade 36 at each end of the blade (Figs. 2, 8, and 16).
As shown in Figure 6, each wing 38, 40 has a blade portion
112. A wear strip 113 is fastened along a lower edge of
blade portion 112 by fasteners 113a. Fasteners 113a are
mounted in apertures which may be elongated to allow
15 vertical adjustment of wear strip 113 to accommodate wear
along its lower edge. Wear strip 113 is preferably made
from ultra high molecular weight (UHMW) polyethylene, but
may be of any material, suitable for protecting the wing 38,
40 from excessive wear. Vertically spaced upper and lower
20 pivot sleeves 114, 116 are provided along a rear edge 118 of
blade portion 112 (Fig. 6). Pivot sleeves align along a
common, vertical pivot axis 120 so that a cooperating plow
blade pivot sleeve 122, provided on each end of plow blade
36, may be interposed between the pivot sleeves 114, 116 for
25 pivotable connection of each wing 38, 40 with plow blade 36
(Fig. 7). Each of the three pivot sleeves 114, 116, and 122
has a generally centered and vertically oriented bore which
aligns coaxially along pivot axis 120 when pivot sleeve 122
is interposed between pivot sleeves 114 and 116. A
30 corresponding pivot pin 124 is inserted through pivot

2090992

1 sleeves 114, 116, and 122 to pin the wing to the plow blade
in a hinge-like manner (Figs. 6 and 7).

5 A wing bias spring 126 is provided to bias each
wing 38, 40 toward a closed position wherein the wings
project generally forward from plow blade 36, forming a
generally U-shaped assembly (Figs. 2, 7, and 8). In the
closed position, wings 38, 40 bear tightly against the
planar end surfaces of blade 36 to seal the ends and prevent
10 escape or spill over of the material being plowed. When
closed, wings 38, 40 each actually extend forwardly, but at
a slight outward angle of about 9.6° as shown in Figure 8.

A spring post 128 extends generally vertically
upward from the top of blade 112 and is positioned forward
of axis 120 (Figs. 6 and 7). Spring post 128 is formed by a
15 weldment of a piece of metal rod stock 130 and two pieces of
plate stock 132 and 134 welded along the length of rod stock
130. The two pieces of plate stock 132 are oriented to
define an approximately 90° angle between them (Fig. 2). A
slot 136 is provided in each plate 132 to expose a portion
20 of rod 130 so that one end of wing bias spring 126 is
connected with spring post 128 by hooking an exposed portion
of rod 130 (Fig. 6). As with the trip springs 104, wing
bias springs 126 extend to an eye bolt 138 which
interconnects with a fastening plate 140, on the back of
25 plow blade 36 (Figs. 2 and 7). Eye bolt 138 is provided to
allow pretension adjustment of wing bias springs 126.

A pair of generally parallel and spaced apart arms
142 are also provided on each wing 38, 40, project generally
outward from blade portion 112, extending along an outside
surface portion of wing blade portion 112, and project
30 rearward from the wing 38, 40, beyond pivot axis 120 (Figs.

2090992

1 2, 6, and 7). Each wing 38, 40 may be rotated to an open
position in which the wings project in generally opposite
directions, away from each other, and effectively extend the
length of the plow blade 36, by pulling projecting ends 146
5 of the arms 142 toward blade carrier 34 (Figs. 2, 6, 7, and
16).

Alternatively to plow wings 38 and 40 as described
above, an all plastic wing may be used as shown in Figure
20. The all plastic wing is preferably made from UHMW
10 polyethylene, but may be made from any suitably durable
plastic. As shown in Figure 20, the all plastic wing has a
plastic blade portion 112' fastened by bolting or riveting
for example, with a mounting plate 115. Upper and lower
pivot sleeves 114', 116' are provided along a rear edge of
15 mounting plate 115. Wing arms 142' extend across mounting
plate 115 and project rearward, beyond wing pivot axis 120'.
Arms 142' may also extend forward over the outside surface
of blade portion 112' for additional stiffening as required.

While a number of devices may be employed to pull
20 the wings 38, 40 from the closed position to the open
position, this is preferably accomplished by cabling
connected with each arm 142 and extending along the back of
plow blade 36 to engage pulleys 76 and attach to support
frame 32, preferably at the ends 82 and 84 of cross member
25 44 (Fig. 2). Specifically as illustrated in Figures 2, 8,
12, and 16, a first length of cable 150 is connected at a
first end with arms 142 of left wing 38 at ends 146, extends
to and around pulleys 76a and 76c, and extends to left end
82 of support frame cross member 44 where the cable is
30 connected by a conventional fastener near a second end. A
loop 152 is formed at the second end of cable 150 for

2090992

1 snugging the cable with a pry bar. Likewise, a second
length of cable 154 is connected at a first end with arm
142 of right wing 40 at ends 146, extends to and around
pulleys 76b and 76d, and is connected by a conventional
5 fastener near a second end with the right end 84 of support
frame cross member 44. A snagging loop 156 is also provided
at the second end of cable 154. Cables 150 and 154 are
clamped together with cable clamps 148, preferably clamping
the cables 150, 154 near the pulleys 76a, 76b, between the
10 pulleys 76a, 76b and the pulleys 76c, 76d.

As shown in the figures, specifically Figure 3,
this routing of cables 150 and 154, in conjunction with the
positioning of pulleys 76a and 76b places the cables running
generally parallel and closely adjacent to trip axis 104.
15 This relation between cables 150 and 154 and axis 104
minimizes any potential to dislodge the cables 150, 154 from
the pulleys 76a, 76b or to unduly stress the cables 150, 154
when plow blade 36 trips and rotates about trip axis 104.

While this specific routing of the cabling is
20 shown in the figures and described, alternative cabling
arrangements will be apparent to those who practice this
invention. One may run a first cable between the wings 38,
40 and a second cable between the ends 82, 84 of support
frame cross member 44 with these two cables routed to
25 interconnect between pulleys 76a and 76b for example. Thus,
the specific cabling arrangement shown and described does
not limit the scope of the invention which is defined by the
claims.

Referring now to Figures 2, 7, and 9-11, a
30 latching mechanism, including a latch arm 158, a wing closed
stop plate 160, and a latch arm guide block 162, is provided

2090992

1 on the rear of plow blade 36 adjacent each blade wing 38, 40
to latch the blade wings in the closed position. Latch arm
158 is a generally U-shaped channel member or valdment
having upper and lower flange plates 164 with an
5 interconnecting web plate 166 holding the flange plates 164
in spaced and generally parallel relationship (Figs. 9, 10,
and 11). Each flange plate 164 is substantially identical
having a first aperture 170 near one end and 172, a closed stop
notch 174 defined midway along a forward facing edge, and a
10 second aperture 176 near a second end 180. A cable sheave
182 extends between the two flange plates 164 and is
positioned in alignment with second aperture 176. Sheave
182 may be a short length of steel tubing, round bar stock,
or the like welded or otherwise connected between the flange
15 plates 164. A wing open stop 184 is mounted on an outside
surface of each flange plate 164. The stops 184 align with
each other and project generally away from each other.

A pivot pin or bolt 186 pivotally connects latch
arm 158 at its first end 172 between projecting ends 146 of
20 the wing arms 142 of each blade wing 38 and 40 (Fig. 9).
Latch arm 158 extends across the back of plow blade 36 from
wing arms 142 and is positioned in guide block 162.

Further to the cabling described above, the
pivotable connections between the latch arms 158 and wing
25 arms 142 also preferably serves as the connecting point for
cables 150 and 154 which, more particularly, are preferably
positioned between the upper and lower flange plates 164 of
the latch arms 158. The cables 150, 154 then extend through
the latch arms 158, between the upper and lower flange
30 plates 164 and past cable sheave 182, with the cables 150,
154 positioned between plow blade 36 and cable sheave 182.

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1 With latch arm 158 positioned in guide block 162, the cables
180, 184 extend through guide block 162.

A guide block 162 projects rearwardly from the
back of plow blade 36 near each of the left and right ends
of plow blade 36 (Figs. 2, 7, 8, 9, 12, and 13). Each guide
block 162 includes generally parallel and spaced apart upper
and lower plates 188, a deflector plate 190 extending
generally perpendicularly between upper and lower plates
188, and a cable sheave 192 located at one end of deflector
plate 190 and also extending generally perpendicularly
between upper and lower plates 188 (Figs. 13-15). A
retainer pin or bolt 194 is provided for retaining latch arm
158 in guide block 162. Retaining pin 194 is positioned in
slots 196 in each of the upper and lower plates 188.
Retaining springs 198 are provided at each of two opposing
ends of retaining pin 194 to bias the retaining pin and in
turn latch arm 158 toward plow blade 36. A pair of spring
blocks 200 are provided on each of the upper and lower
plates 188. Retaining springs 198 bear against blocks 200
for biasing retaining pin 194 toward plow blade 36.

In operation, cables 150 and 154 are preferably
slightly slack when plow blade 36 is in the centered or a
generally centered position (Fig. 8). As plow blade 36 is
rotated off-center to the right for example (Fig. 12),
pulleys 76c and 76d move toward the left of longitudinal
frame member 48, pulling right cable 154 tight while left
cable 150 further slackens. However, since cables 150 and
154 are tied together by cable clamps 148, the tightening
right cable 154 also pulls a portion of left cable 150,
between cable clamps 148 and left blade wing 38, tight. As
plow blade 36 is rotated farther off-center (Fig. 15), cable

2090992

1 154 and the portion of cable 150 continue to tighten,
pulling blade wings 38, 40 against the biasing force of
springs 126. Because cables 150 and 154 run through latch
arms 158 and guide blocks 162 and between cable sheaves 168
5 and 192, the second end 180 of each latch arm 158 is pulled
away from plow blade 36, against the biasing force of
springs 198 acting against pins 194, pulling closed stop
notches 174 away from closed stop plate 160 and releasing
latch arms 158, as the cables 150, 154 tighten. While plow
10 blade 36 continues to rotate substantially away from the
centered position, pulley 764 continues to pull on right
cable 154, in turn pulling on both cables and both wing arms
142, and rotates the blade wings 38, 40 to the open position
(Fig. 16). The extension of wings 38 and 40 to the open
15 position is limited by wing open stops 184 engaging the
upper and lower plates 188 of guide blocks 162.

This process reverses itself as the plow blade 36
is returned to the centered position, pulley 764 swings back
over and adjacent to longitudinal frame member 46, and the
20 right cable is released to its slackened position. As right
cable 154 is released, tension in cables 150 and 154 pulling
on the blade wing arms 142 is released and wing bias springs
126 pull the wings 38, 40 back to the closed position.
Further, tension is relieved in cables 150 and 154, the
25 cables slacken and retaining springs 198 bias retaining pins
194 in each guide block 162 toward plow blade 36, relocking
latch arms 158 by the engagement of closed stop notches 174
with closed stop plates 160.

In the alternative to the cabling 150, 154,
30 latching mechanism, including latch arms 158 and guide
blocks 162, and lower plow carrier frame member 56 with

2090992

1 pulleys 76, an actuator comprising a mechanical power source
for opening and closing wings 38, 40 and a control
responsive to the position of plow blade 36 relative to
support frame 32 may be used. According to this alternative
5 embodiment, shown in Figures 21-23, each of a pair of
hydraulic cylinders 210 has a head and pivotally connected
via support plates 211 and pivot pin 211a with plow blade 36
and has a rod and pivotally connected via pivot pin 211b with
wing arms 142 of each wing 38 and 40 (Figs. 21-23).
10 Cylinders 210 are preferably 8.46 inch (13.87 cm) stroke
double-acting cylinders having a 1.38 inch (3.5 cm) rod and
a 2.5 inch (6.35 cm) bore. However, those who practice this
invention may find other commonly available hydraulic
cylinders to perform satisfactorily.

15 Cylinders 210 are connected in parallel through
hydraulic lines 212 and 214 with a spool valve 216 (Fig.
22). As with spool valve 94, discussed above, spool valve
216 may be any of various control valves commonly available,
including a Gressen V20, open center directional control
20 valve having three-position, four-way solenoid operation
with the spool blocked in neutral and both port and main
reliefs for example. Hydraulic fluid is supplied to spool
valve 216 through pump 88 and a proportional diverter 220.
Hydraulic fluid returning through spool valve 216 from
25 cylinders 210 passes through filter 222 to reservoir 86.
Spool valve 216 is also electrically connected with a pair
of cam operated limit switches 226 and 228 which are wired
in parallel and follow cams 230 and 232, respectively,
provided on slide plate 72. The limit switches are
30 preferably weather proof and may each be double pole, single
throw designs or have two single pole, double throw

2090992

1 circuits, such as in the Micro-Switch brand environment
proof limit switch model 1CH1-1.

As shown in Figure 22, the limit switches 226, 228
are connected with an operator switch 234 which also
5 controls the hydraulic circuit and spool valve 94 for
controlling rotation of plow blade 36. Operator switch 234
may be any of various double pole, double throw switches
which are commonly available, including the Cutler Hammer
model 8511-K2. While the blade rotation hydraulic circuit
10 of Figure 17 is shown in Figure 22, the circuits of Figures
18 and 19, or other commonly known hydraulic circuits
serving the same function, may be satisfactorily substituted
in Figure 22.

In operation, plow blade 36 is angled left from
15 the centered position when an operator manipulates switch
234 to a left position "L", energizing coil 236 of valve 94
to direct hydraulic fluid to cylinder 80 through line 238
(Fig. 22). Manipulating switch 234 to the left position
also energizes contacts 240 and 242 of the limit switches
20 226, 228, respectively (Figs. 22 and 23). While plow blade
36 swings left, slide plate 72 swings cam 230 and 232 past
limit switches 226 and 228, respectively. Switch 228
follows cam 232 toward slide plate 72 and keeps its contacts
open, but switch 226 follows cam 230 away from slide plate
25 72 and closes its contacts. Thus, coil 244 of spool valve
216 is energized through limit switch 226 as the limit
switch follows cam 230 and spool valve 216 directs hydraulic
fluid to the rod end of cylinders 210 to retract the
cylinder rods and rotate the wings 38, 40 to the open
30 position. Flow divider 220 is preferably adjusted so that

2090992

1 the wings 38, 40 will fully open prior to plow blade 36
being fully angled to the left.

5 The plow blade 36 may be rotated to the right from
the left position by manipulating operator switch 234 to a
right position "R" and energize coil 246 of valve 94 to
direct hydraulic fluid to cylinder 78 through line 248.
With operator switch 234 in the right position, contacts 230
and 232 of limit switches 226, 228, respectively, are also
energized. Since the contacts in switch 226 are closed,
10 coil 234 of spool valve 216 is now energized and spool valve
216 directs hydraulic fluid through line 212 to the head end
of each cylinder 210 to extend the cylinder rods and rotate
the wings 38, 40 to the closed position.

15 While plow blade 36 swings right to the centered
position, slide plate 72 swings cam 230 and 232 past limit
switches 226 and 228, respectively. Switch 228 does not
engage cam 232 until plow blade 36 swings past the centered
position to a right angled position, thus the contacts of
switch 228 remain open until after the centered position is
20 obtained. However, switch 226 follows cam 230 and keeps its
contacts closed until plow blade 36 approaches the centered
position. When plow blade 36 rotates to a generally
centered position, switch 226 follows cam 230 toward slide
plate 72, opening its contacts. Thus, in the generally
25 centered position, neither coil 234 or 244 of solenoid valve
216 are energized.

The plow blade 36 may continue to rotate to the
right or initially be rotated to the right from the centered
position by having the operator switch 234 in the right
30 position "R". This energizes coil 246 of solenoid valve 94
to direct hydraulic fluid through line 248 to cylinder 78.

2090992

This also energizes contacts 230 and 232 of limit switches 226 and 228, respectively. Again, slide plate 72 and cam 230 and 232 swing past limit switches 226 and 228, respectively, while plow blade 32 swings to the right.

5 Switch 226 follows cam 230 towards slide plate 72 and keeps its controls open, but switch 228 follows cam 232 away from slide plate 72 and closes its contacts. Thus, coil 244 of spool valve 216 is energized through limit switch 228 as the limit switch follows cam 232 and spool valve 216 directs
10 hydraulic fluid to the rod end of each cylinder 210 to retract the cylinder rods and rotate the wings 38, 40 to the open position.

Manipulating the operator switch 234 to the left position "L" will eventually return plow blade 36 to the
15 centered position by rotating the blade from right to left. Again, contacts 240 and 242 of limit switches 226 and 228, respectively, are energized when switch 234 is in the left position. However, since the plow blade 36 is initially
20 starting from a right rotated position, the contacts of switch 226 are open and the contacts of switch 228 are closed so that coil 254 of spool valve 216 is now energized and spool valve 216 directs hydraulic fluid to the head ends
25 of each cylinder 210 to extend the cylinder rods and rotate the wings 38, 40 to the closed position while plow blade 36 rotates from a right position to the center position.

A second alternative embodiment of the actuator includes a series of mechanical linkages interconnecting each of wings 38, 40 with support frame 32 as shown in
30 Figures 26-32. The actuator includes a link 274, a pair of toggle arms 280 and 282, a pair of ball cranks 284 and 286,

2090992

1 and a pair of rod members 288 and 290 (Figs. 26, 27, and
30).

5 In this embodiment, support frame longitudinal
frame member 48 has an extension 270 which projects forward
beyond plow carrier transverse carrier member 58, through a
slot 272 (Figs. 28 and 33). One end of link 274 is
pivotally connected with longitudinal frame member 48 at the
end of extension 270 by a pivot pin 276 or the like (Figs.
32 and 28). Link 274 extends rearward from pivot 276 to a
10 slide pin 278, which is located in a slot 292 (Fig. 28).
Slot 292 has a generally forward/rearward orientation and is
formed in each of an upper flange 294 and lower flange 296
of a generally rearward extending channel portion 298 of
lower frame member of plow carrier 34.

15 Because the left and right portions of the
actuator are substantially mirror images of one another,
only one side of the actuator will be discussed below with
the understanding that the discussion will apply equally in
mirror image to the other side of the actuator. Toggle arm
20 282 is an elongated member having a notched end 302, having
a second end 306 opposite notched end 302, and being
pivotally mounted in channel portion 298 by pivot 310 (Figs.
31 and 32). Pivot 310 of toggle arm 282 is offset toward
notched end 302 to define a relatively shorter lever arm
25 between the pivot 310 and notched end 302 and a relatively
longer lever arm between pivot 310 and second end 306 so
that motion of notched end 302 is amplified at second end
306.

30 Second end 306 of toggle arm 282 is in turn
connected with a short lever 312 of bell crank 284 by a pair
of link plates 314. Link plates 314 are positioned on

2090992

1 opposing sides of each of toggle arm 282 and lever 312 to
sandwich the toggle arm and lever between the link plates.
Further, link plates 314 are pivotally connected at one end
with toggle arm 282 and pivotally connected at an opposing
5 end with short lever 312.

Bell crank 284 is an assembly of short lever 312,
a pivot shaft 316, and a long lever 318. The use of short
lever 312 and long lever 318 provides amplification at an
end 320 of long lever 318, away from pivot shaft 316, of
10 motion transferred from link plates 314 to short lever 312.
Bell crank 284 is pivotally mounted in transverse carrier
member 58 with long lever 318 extending generally forward
beyond transverse carrier member 58 through a slot 320 (Fig.
29). Pivot shaft 316 extends generally upward from short
15 lever 312 through transverse carrier member 58 and long
lever 318.

Long lever 318 may have a hub portion 322 which is
keyed to shaft 316 by a key 324. Long lever 318 is
connected at end 320 to rod member 290 by link plates 326 in
20 the same manner that link plates 314 interconnect toggle arm
282 and short lever 312.

Rod member 290 extends across the back of plow
blade 36 toward wing 40 (Figs. 26 and 27). Further, rod
member 290 extends coaxially along trip axis 104 to avoid
25 any tendency to bind when blade 36 is tripped and rotates
forward and downwardly about trip axis 104. Thus, rod
member 290 is most preferably the hinge pin which
interconnects plow carrier 34 and plow blade 36 through
pivot plates 100 and pivot members 102. While rod member
30 290 may be torsionally preloaded to bias blade 36 toward its
untripped vertical position, trip springs 103 are preferably

1 used for this purpose as described above and rod member 290
is provided with a swivel joint 328 to avoid torsional
loading (Fig. 26).

5 Rod member 290 is interconnected with wing 40 by a
link 330 (Figs. 26 and 27). Link 330 is pivotally connected
at one end with wing arm end 146 and at a second end
opposite the one end, with rod member 290. Further, swivel
joint 328 (Fig. 26) may incorporate both the swivel joint
function and the pivotal connection with link 330 in a
10 single fitting.

In operation of the second alternative embodiment
of the actuator including the series of mechanical linkages
just described, plow blade 36 may be rotated from a
generally centered position (Fig. 26) to an off-center or
15 angled position (Fig. 27) by operation of cylinders 78 and
80 as discussed above. While plow blade 36 is rotated
off-center toward the right for example, channel portion 298
moves to the left of longitudinal frame member 48 and the
interconnection between link 274 and longitudinal frame
20 member 48 causes slide pin 278 to move rearward relative to
slot 292 and each of toggle arms 280 and 282. Thus, while
slide pin 278 moves rearward, its interconnection with each
of the toggle arms 280, 282 rotates toggle arm 280 clockwise
and toggle arm 282 counterclockwise when viewed from above.
25 The interconnection of toggle arm 280 with bell crank 284 in
turn rotates bell crank 284 in a clockwise direction.
Likewise, bell crank 284 is rotated in a counterclockwise
direction by toggle arm 282. The rotation of each of the
ball cranks 284 and 286 pulls rod members 288 and 290,
30 respectively, inward, toward each other, along trip axis
104. Each of the rod members 288, 290 in turn pull on the

2090992

1 wing arm end 146 of its respective wing 38 and 40, rotating
wings 38 and 40 to the open position.

Rotating plow blade 36 from a right angled
position toward the centered position substantially reverses
5 the operation just described with the result that rod
members 288 and 290 are pushed away from each other and push
wing ends 146 generally outward to close wings 38, 40.
Continued rotation of plow blade 36 past the centered
position toward a left angled position swings channel
10 portion 298 to the right of longitudinal frame member 48
with the result that slide pin 278 is again moved rearward
in slot 292 by link 274 with the same result of the wings
38, 40 being rotated to the open position as discussed above
relative to rotation of plow blade 36 to a right angle
15 position.

The above description is considered that of the
preferred embodiments only. It will be clear to those
skilled in the art and to those who practice the invention
that the embodiments of the invention described above may be
20 modified, including modification to manipulate the wings 38,
40 independently for the best effect under various
circumstances, such as opening only the trailing wing with
the leading wing closed or only partially opened when plow
blade 36 is rotated substantially off-center for example.
25 Therefore, it is understood that the embodiments shown in
the drawings and described above are merely for illustrative
purposes and are not intended to limit the scope of the
invention, which is defined by the following claims as
interpreted according to the principles of patent law.

30

2090992

1 The embodiments of the invention in which an
exclusive property or privilege is claimed are defined as
follows.

-1-

1 A winged plow assembly for use with a vehicle,
comprising:

3 a support frame for pivotal connection with the
vehicle, said support frame adapted to extend away from the
5 vehicle along a longitudinal centerline of the vehicle, and
said support frame having a longitudinal axis oriented
generally parallel with the vehicle centerline;

10 an elongated plow blade having two opposing ends
and pivotally connected with said support frame for
generally horizontal rotation of said plow blade between a
centered position with said plow blade oriented generally
perpendicular to said support frame longitudinal axis and a
number of angled positions with said plow blade oriented at
an angle relative to said support frame longitudinal axis;

15 a pair of plow blade wings, one of said pair of
wings being pivotally connected with one end of said plow
blade and the other of said pair of wings being pivotally
connected with an opposing end of said plow blade for
rotation of each said wing between a closed position in
20 which said wings project generally forwardly, said wings and
said plow blade defining a generally U-shaped assembly in
said closed position so that said wings facilitate pushing
material with said plow assembly, and an open position in
which said wings project in generally opposite directions,
25 away from each other to effectively extend the length of
said plow blade so that said wings facilitate moving
material to the side of the plow assembly; and

(29)

2090992

30 actuator means responsive to the position of said
plow blade relative to said support frame for rotating at
least one of said wings between said closed position when
said plow blade is substantially in said centered position
and said open position when said plow blade is rotated
substantially away from said centered position.

-2-

1 The plow assembly defined in claim 1 wherein said
actuator means includes at least one cable interconnecting
at least one of said wings with said support frame for
pulling at least one of said wings into said open position
3 when said plow blade is rotated substantially away from said
centered position.

-3-

1 The plow assembly defined in claim 2 wherein said
actuator means includes a first cable portion operatively
interconnecting said one of said pair of wings with said
support frame and a second cable portion operatively
5 interconnecting said other of said pair of wings with said
support frame, said first and second cable portions pulling
both of said wings to said open position when said plow
blade is rotated substantially away from said centered
position.

-4-

1 The plow assembly defined in claim 2 further
including a biasing means connected between said plow blade
and each of said wings for biasing said wings to said closed
position.

-5-

1 The plow assembly defined in claim 4 wherein said
actuator means further includes a latch for latching said

2090992

wings in said closed position when said plow blade is substantially in said centered position and for releasing said wings from said closed position when said plow blade is rotated substantially away from said centered position.

-4-

The plow assembly defined in claim 3 wherein said plow blade is pivotally connected with said support frame for rotation of said plow blade about a generally horizontal axis between a normally generally vertical position and a generally horizontal position, and the plow assembly further includes trip biasing means for biasing said plow blade to said generally vertical position.

-7-

The plow assembly defined in claim 6 further including a power rotation device for rotating said plow blade between said centered position and said angled positions.

-8-

The plow assembly defined in claim 7 wherein said power rotation device includes a pair of hydraulic cylinders, one of said cylinders being positioned along a first side of said support frame and connected between said support frame and said plow blade, a second of said cylinders being positioned along a second side of said support frame opposite said one cylinder and connected between said support frame and said plow blade.

-9-

The plow assembly defined in claim 2 wherein:
said plow blade is pivotally connected with said support frame for rotation of said plow blade about a

2090992

generally horizontal axis between a normally generally
vertical position and a generally horizontal position;

the plow assembly further includes trip biasing
means for biasing said plow blade to said generally vertical
position;

said cable has a first portion extending between
one of said wings and said support frame and a second
portion extending between the other of said wings and said
support frame; and

each of said first and second cable portions is
positioned adjacent said horizontal axis.

-10-

The plow assembly defined in claim 9 further
including a power rotation device for rotating said plow
blade between said centered position and said angled
positions.

-11-

The plow assembly defined in claim 10 wherein said
power rotation device includes a pair of hydraulic
cylinders, one of said cylinders being positioned along a
first side of said support frame and connected between said
support frame and said plow blade, a second of said
cylinders being positioned along a second side of said
support frame opposite said one cylinder and connected
between said support frame and said plow blade.

-12-

The plow assembly defined in claim 1 wherein said
actuator means includes at least one cable connected with
each of said pair of wings and said support frame for
pulling said wings into said open position when said plow
blade is rotated into one of said angled positions.

(32)

2090992

-13-

1 The plow assembly defined in claim 12 wherein said actuator means rotates said wings substantially simultaneously between said closed and said open positions.

-14-

1 The plow assembly defined in claim 1 wherein said actuator means further includes a latch for latching said wings in said closed position when said plow blade is substantially in said centered position and for releasing
3 said wings from said closed position when said plow blade is rotated substantially away from said centered position.

-15-

1 The plow assembly defined in claim 1 wherein said plow blade is pivotally connected with said support frame for rotation of said plow blade about a generally horizontal axis between a normally generally vertical position and a
5 generally horizontal position, and the plow assembly further includes trip biasing means for biasing said plow blade to said generally vertical position.

-16-

1 The plow assembly defined in claim 1 wherein said actuator means includes a mechanical power source and a control for said mechanical power source, said power source being connected with at least one of said pair of wings for
3 manipulating said one wing between said open and closed positions in response to said control; said control being adapted for sensing the position of said plow blade relative to said support frame, for sending an open signal to said mechanical power source when said plow blade is rotated
10 substantially away from said centered position so that said mechanical power source opens at least said one wing, and

(33)

2090992

for sending a close signal to said mechanical power source
when said plow blade is substantially in said centered
position so that said mechanical power source closes at
least said one wing.

-17-

The plow assembly defined in claim 16 wherein said
mechanical power source includes at least one hydraulic
cylinder interconnected between said plow blade and at least
said one wing.

-18-

The plow assembly defined in claim 17 wherein said
mechanical power source includes said one hydraulic cylinder
interconnected between said plow blade and said one wing and
a second hydraulic cylinder interconnected between said plow
blade and the other of said pair of wings.

-19-

The plow assembly defined in claim 1 wherein said
actuator means includes a series of linkages operatively
interconnecting at least one of said pair of wings with said
support frame.

-20-

The plow assembly defined in claim 19 wherein said
actuator means further includes a rod member operatively
connected between said one of said pair of wings and said
series of linkages.

-21-

The plow assembly defined in claim 20 wherein said
plow blade is pivotally connected with said support frame
for rotation of said plow blade about a generally horizontal
axis between a normally generally vertical position and a
generally horizontal position, and the plow assembly further

(34)

2090992

includes trip biasing means for biasing said plow blade to said generally vertical position.

-22-

1 The plow assembly defined in claim 21 wherein said rod member extends coaxially along said horizontal axis.

-23-

1 The plow assembly defined in claim 1 wherein said actuator means includes a first series of mechanical linkages operatively interconnecting one of said pair of wings with said support frame and includes a second series
5 of mechanical linkages operatively interconnecting a second of said pair of wings with said support frame.

-24-

1 The plow assembly defined in claim 23 wherein said plow blade is pivotally connected with said support frame for rotation of said plow blade about a generally horizontal axis between a normally generally vertical position and a
5 generally horizontal position, and the plow assembly further includes trip biasing means for biasing said plow blade to said generally vertical position.

-25-

1 The plow assembly defined in claim 24 wherein said actuator means further includes a first rod member operatively connected between said one of said pair of wings and said first series of mechanical linkages and a second
5 rod member operatively connected between said second of said pair of wings and said second series of mechanical linkages and wherein each of said first and second rod members extend coaxially along said horizontal axis.

2090992

-16-

1 A winged plow assembly for use with a vehicle to
push material from a surface to be cleared, comprising:

5 a support frame for pivotal connection with the
vehicle, said support frame adapted to extend away from the
vehicle along a longitudinal centerline of the vehicle, and
said support frame having a longitudinal axis oriented
generally parallel with the vehicle centerline;

10 an elongated plow blade having two opposing ends
and pivotally connected with said support frame for
generally horizontal rotation of said plow blade between a
centered position with said plow blade oriented generally
perpendicular to said longitudinal axis and a number of
15 angled positions with said plow blade oriented at an angle
relative to said longitudinal axis and for rotation of said
plow blade about a generally horizontal axis between a
normally generally vertical position and a generally
horizontal position when a bottom edge of said plow blade
engages a protrusion on a surface to be plowed clear;

20 a pair of plow blade wings, one of said pair of
wings being pivotally connected with one end of said plow
blade and the other of said pair of wings being pivotally
connected with an opposing end of said plow blade for
rotation of each said wing between a closed position in
which said wings project generally forwardly, said wings and
25 said plow blade defining a generally U-shaped assembly in
said closed position so that said wings facilitate pushing
material with said plow assembly, and an open position in
which said wings project in generally opposite directions,
away from each other to effectively extend the length of
30 said plow blade so that said wings facilitate moving
material to the side of the plow assembly; and

2990992

35 actuator means responsive to the position of said
plow blade relative to said support frame for rotating at
least one of said wings between said closed position when
said plow blade is substantially in said centered position
and said open position when said plow blade is rotated
substantially away from said centered position.

-27-

1 The plow assembly defined in claim 26 wherein said
actuator means includes at least one cable interconnecting
at least said one wing with said support frame for pulling
said one wing into said open position when said plow blade
5 is rotated substantially away from said centered position.

-28-

1 The plow assembly defined in claim 27 wherein said
cable has a first portion extending between one of said
wings and said support frame and a second portion extending
between the other of said wings and said support frame and
5 each of said first and second cable portions is positioned
adjacent said horizontal axis.

-29-

1 The plow assembly defined in claim 28 further
including a biasing means connected between said plow blade
and each of said wings for biasing said wings to said closed
position.

-30-

1 The plow assembly defined in claim 29 further
including trip biasing means for biasing said plow blade to
said generally vertical position.

-31-

1 The plow assembly defined in claim 28 wherein said
actuator means further includes a latch for latching said

(37)

2090992

5 wings in said closed position when said plow blade is
substantially in said centered position and for releasing
said wings from said closed position when said plow blade is
rotated substantially away from said centered position to
one of said angled positions.

-32-

1 The plow assembly defined in claim 31 wherein said
latch includes:

a first latch plate on said plow blade near said
one wing;

5 a first latch arm extending from said one wing,
said first latch arm being adapted for latching engagement
with and release from said first latch plate;

a second latch plate on said plow blade near said
other wing; and

10 a second latch arm extending from said other wing,
said second latch arm being adapted for latching engagement
with and release from said second latch plate.

-33-

1 The plow assembly defined in claim 31 further
including a power rotation device having a pair of hydraulic
cylinders for rotating said plow blade between said centered
position and said angled positions, one of said cylinders
3 connecting between each of two opposing sides of said
support frame and said plow blade.

-34-

1 The plow assembly defined in claim 26 wherein said
actuator means includes a mechanical power source connected
with at least one of said wings for manipulating at least
said one wing between said open and closed positions in
3 response to a control and a control for said mechanical

(38)

2090992

power source, said control being adapted for sensing the position of said plow blade relative to said support frame, for sending an open signal to said mechanical power source when said plow blade is rotated substantially away from said centered position so that said mechanical power source opens said one wing, and for sending a close signal to said mechanical power source when said plow blade is substantially in said centered position so that said mechanical power source closes said one wing.

-35-

1 The plow assembly defined in claim 34 further including trip biasing means for biasing said plow blade to said generally vertical position.

-36-

1 The plow assembly defined in claim 35 further including a power rotation device having a pair of hydraulic cylinders for rotating said plow blade between said centered position and said angled positions, one of said cylinders connecting between each of two opposing sides of said support frame and said plow blade.

-37-

1 The plow assembly defined in claim 36 wherein said actuator means includes a series of linkages operatively interconnecting at least one of said two pair of wings with said support frame.

-38-

1 The plow assembly defined in claim 37 wherein said actuator means further includes a rod member operatively connected between said one of said pair of wings and said series of linkages.

2090992

-39-

1 The plow assembly defined in claim 38 wherein said
rod member extends coaxially along said horizontal axis.

-40-

1 The plow assembly defined in claim 36 wherein said
actuator means includes a first series of mechanical
linkages operatively interconnecting one of said pair of
wings with said support frame and includes a second series
3 of mechanical linkages operatively interconnecting a second
of said pair of wings with said support frame.

-41-

1 The plow assembly defined in claim 40 wherein said
actuator means further includes a first rod member
operatively connected between said one of said pair of wings
and said first series of mechanical linkages and a second
3 rod member operatively connected between said second of said
pair of wings and said second series of mechanical linkages
and wherein each of said first and second rod members extend
coaxially along said horizontal axis.

-42-

1 A winged plow assembly for use with a vehicle,
comprising:

a support frame for pivotal connection with the
vehicle, said support frame adapted to extend away from the
5 vehicle along a longitudinal centerline of the vehicle, and
said support frame having a longitudinal axis oriented
generally parallel with the vehicle centerline;

an elongated plow blade having two opposing ends
and pivotally connected with said support frame for
10 generally horizontal rotation of said plow blade between a
centered position with said plow blade oriented generally
perpendicular to said longitudinal axis and a number of

(40)

2090992

angled positions with said plow blade oriented at an angle relative to said longitudinal axis;

15 a pair of plow blade wings, one of said pair of wings being pivotally connected with one end of said plow blade and the other of said pair of wings being pivotally connected with an opposing end of said plow blade for rotation of each said wing between a closed position in
20 which said wings project generally forwardly, said wings and said plow blade defining a generally U-shaped assembly in said closed position so that said wings facilitate pushing material with said plow assembly, and an open position in
25 which said wings project in generally opposite directions, away from each other to effectively extend the length of said plow blade so that said wings facilitate moving material to the side of the plow assembly; and

actuator means responsive to the position of said plow blade relative to said support frame for manipulating
30 at least one of said wings between said closed position when said plow blade is substantially in said centered position and said open position when said plow blade is rotated substantially away from said centered position, said actuator means including holding means for holding said
35 wings in said closed position when said plow blade is substantially in said centered position.

-43-

1 The plow assembly defined in claim 42 wherein said actuator means interconnects said wings with said support frame so that said wings rotate between said closed position when said plow blade is in said centered position and said
5 open position when said plow blade is in one of said angled positions.

(41)

2090992

-44-

1 The plow assembly defined in claim 43 wherein said
actuator means includes cable means for interconnecting said
wings with said support frame for pulling said wings into
said open position when said plow blade is rotated
3 substantially away from said centered position.

-45-

1 The plow assembly defined in claim 44 wherein said
holding means includes:

 a first latch plate on said plow blade near said
one wing;

3 a first latch arm extending from said one wing,
said first latch arm being adapted for latching engagement
with and release from said first latch plate;

 a second latch plate on said plow blade near said
other wing; and

10 a second latch arm extending from said other wing,
said second latch arm being adapted for latching engagement
with and release from said second latch plate.

-46-

1 The plow assembly defined in claim 44 wherein said
plow blade is pivotally connected with said support frame
for rotation of said plow blade about a generally horizontal
axis between a normally generally vertical position and a
3 generally horizontal position, and the plow assembly further
includes trip biasing means for biasing said plow blade to
said generally vertical position.

-47-

1 The plow assembly defined in claim 44 wherein said
cable means includes a first cable portion extending between
one of said wings and said support frame and a second cable

(43)

2090992

portion extending between the other of said wings and said support frame and each of said first and second cable portions is positioned adjacent said horizontal axis.

-48-

The plow assembly defined in claim 47 further including a biasing means connected between said plow blade and each of said wings for biasing said wings to said closed position.

-49-

The plow assembly defined in claim 48 further including a power rotation device having a pair of hydraulic cylinders for rotating said plow blade between said centered position and said angled positions, one of said cylinders being positioned along a first side of said support frame and connected between said support frame and said plow blade, a second of said cylinders being positioned along a second side of said support frame opposite said one cylinder and connected between said support frame and said plow blade.

-50-

The plow assembly defined in claim 42 wherein said actuator means includes a mechanical power source connected with at least said one wing for manipulating at least said one wing between said open and closed positions in response to a control and a control for said mechanical power source, said control being adapted for sensing the position of said plow blade relative to said support frame, for sending an open signal to said mechanical power source when said plow blade is rotated substantially away from said centered position so that said mechanical power source opens at least said one wing, and for sending a close signal to said

(43)

2090992

mechanical power source when said plow blade is substantially in said centered position so that said mechanical power source closes at least said one wing.

-51-

1 The plow assembly defined in claim 30 wherein said
plow blade is pivotally connected with said support frame
for rotation of said plow blade about a generally horizontal
axis between a normally generally vertical position and a
3 generally horizontal position when a bottom edge of said
plow blade engages a protrusion from a surface to be cleared
of material, the protrusion resisting said plow blade
pushing the protrusion, and the plow assembly further
includes trip biasing means for biasing said plow blade to
10 said generally vertical position.

-52-

1 The plow assembly defined in claim 51 further
including a power rotation device having a pair of hydraulic
cylinders for rotating said plow blade between said centered
position and said angled positions, one of said cylinders
3 connecting between each of two opposing sides of said
support frame and said plow blade.

-53-

1 The plow assembly defined in claim 42 wherein said
actuator means includes a series of linkages operatively
interconnecting at least one of said two pair of wings with
said support frame.

-54-

1 The plow assembly defined in claim 53 wherein said
actuator means further includes a rod member operatively
connected between said one of said pair of wings and said
series of linkages.

(44)

2090992

-35-

1 The plow assembly defined in claim 34 wherein said
plow blade is pivotally connected with said support frame
for rotation of said plow blade about a generally horizontal
axis between a normally generally vertical position and a
3 generally horizontal position, and the plow assembly further
includes trip biasing means for biasing said plow blade to
said generally vertical position.

-36-

1 The plow assembly defined in claim 35 wherein said
rod member extends coaxially along said horizontal axis.

-37-

1 The plow assembly defined in claim 42 wherein said
actuator means includes a first series of mechanical
linkages operatively interconnecting one of said pair of
wings with said support frame and includes a second series
3 of mechanical linkages operatively interconnecting a second
of said pair of wings with said support frame.

-38-

1 The plow assembly defined in claim 37 wherein said
plow blade is pivotally connected with said support frame
for rotation of said plow blade about a generally horizontal
axis between a normally generally vertical position and a
3 generally horizontal position, and the plow assembly further
includes trip biasing means for biasing said plow blade to
said generally vertical position.

-39-

1 The plow assembly defined in claim 38 wherein said
actuator means further includes a first rod member
operatively connected between said one of said pair of wings
and said first series of mechanical linkages and a second

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3 rod member operatively connected between said second of said pair of wings and said second series of mechanical linkages and wherein each of said first and second rod members extend coaxially along said horizontal axis.



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1/14

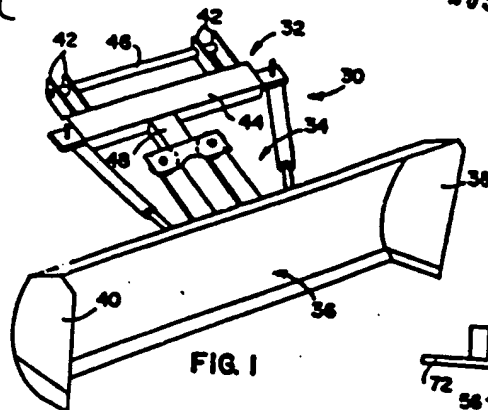


FIG. 1

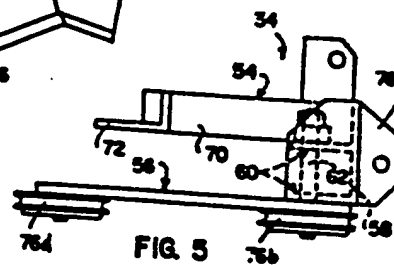


FIG. 5

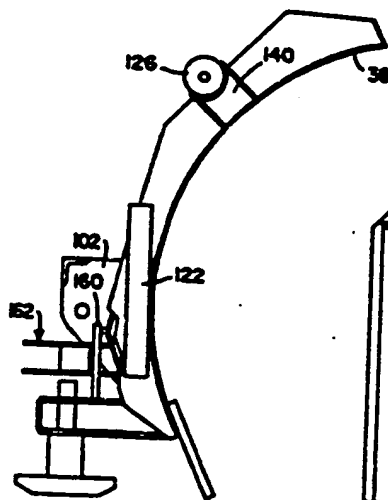


FIG. 4

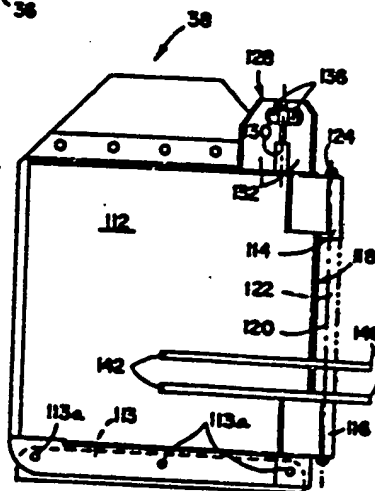


FIG. 6

Full & Style

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2/2

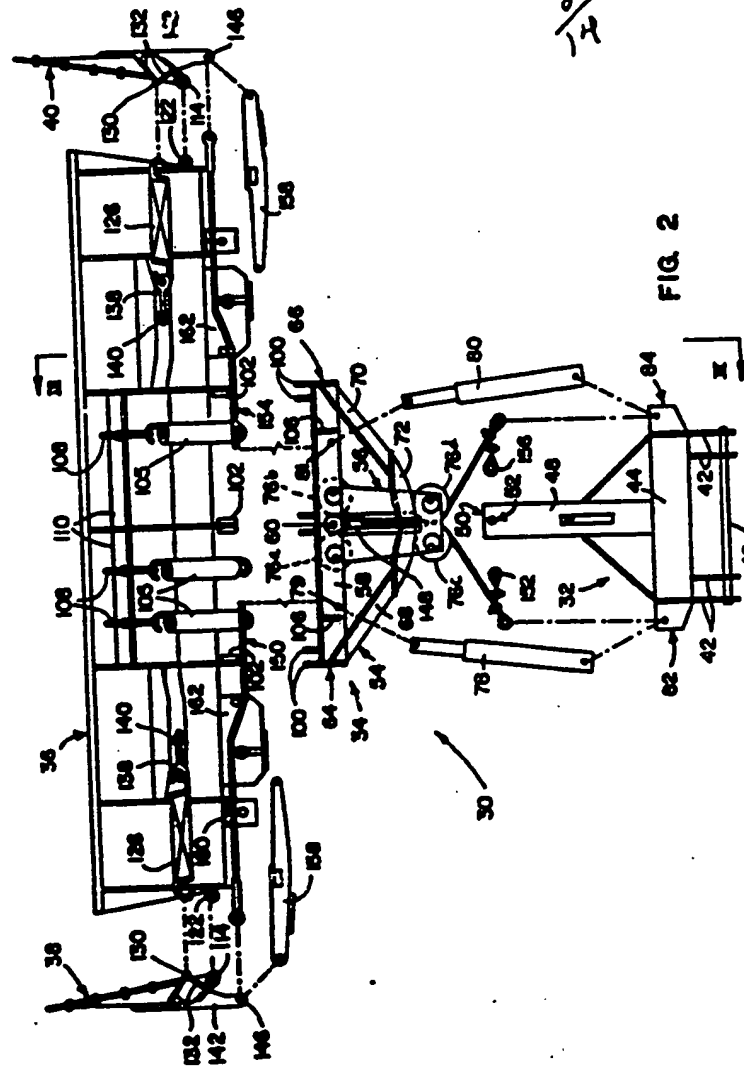


FIG. 2

End of Sheet

2090992 3/4

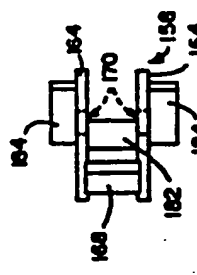


FIG. 11

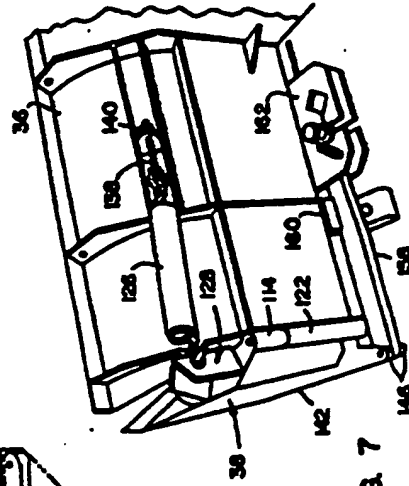


FIG. 7

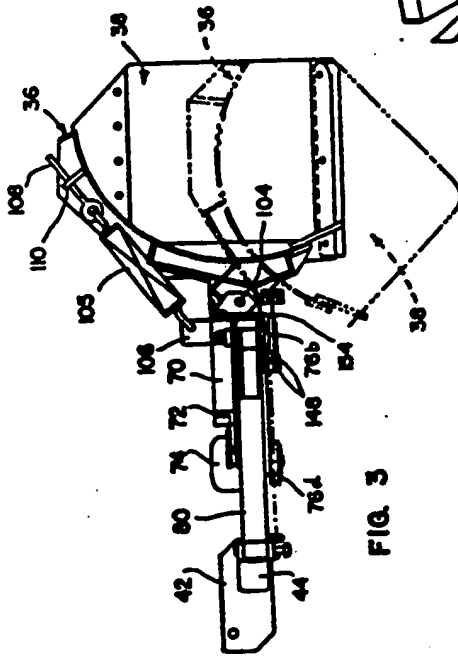
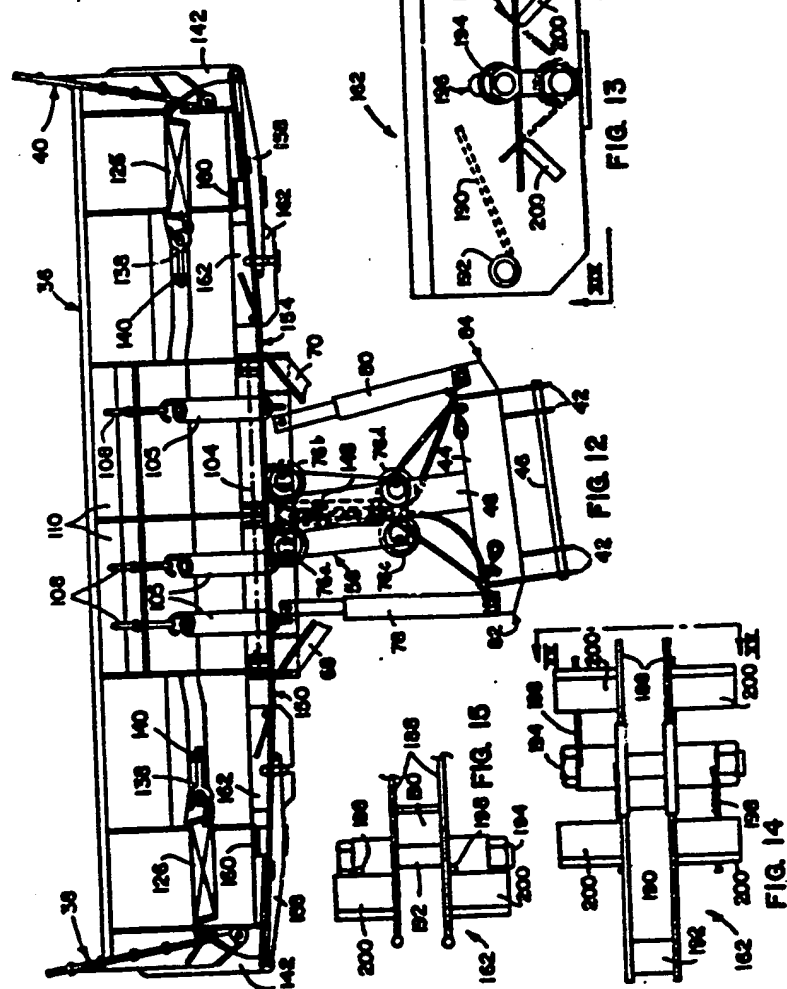


FIG. 3

Full & Style

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5/14



Leak & Sykes

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6/14

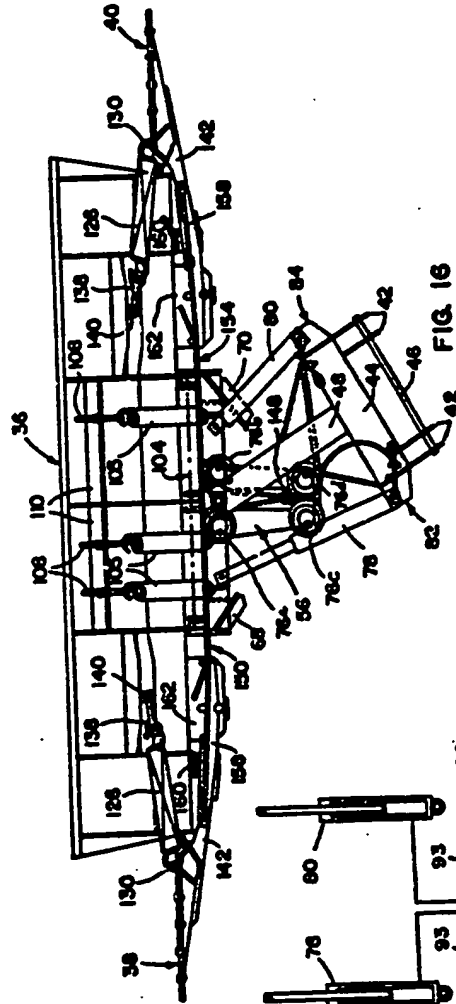


FIG. 16

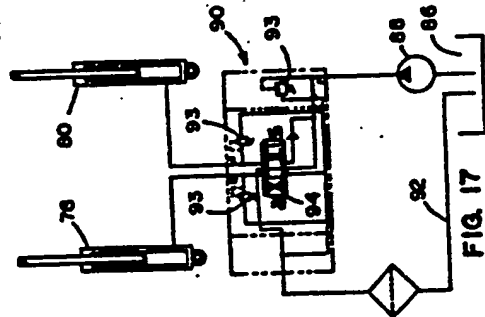


FIG. 17

Smith & Jones

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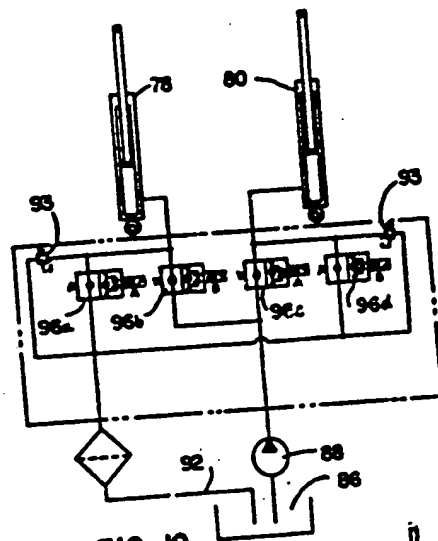


FIG. 19

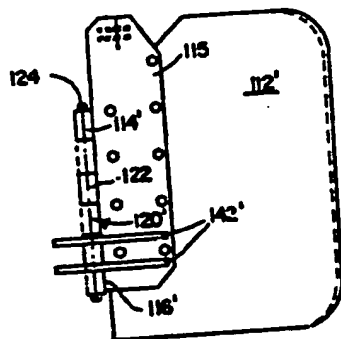


FIG. 20

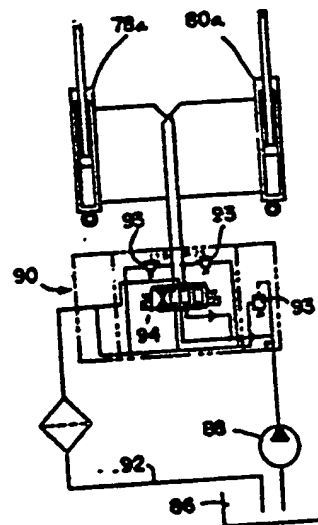


FIG. 18

Scott & Sykes

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9/4

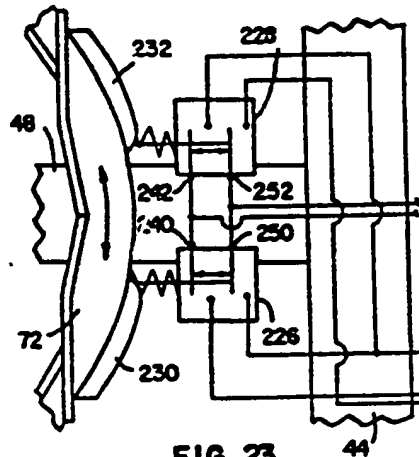


FIG. 23

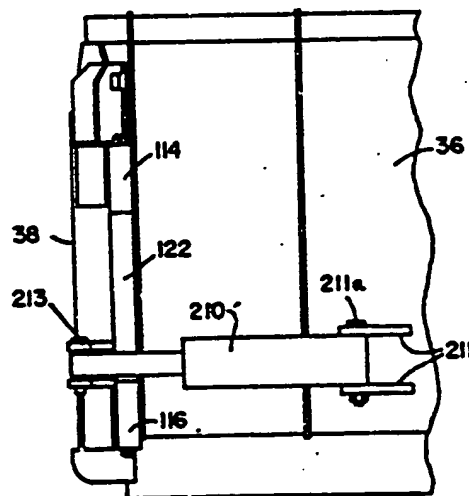


FIG. 21

Scott & Sykes

2090992

9/14

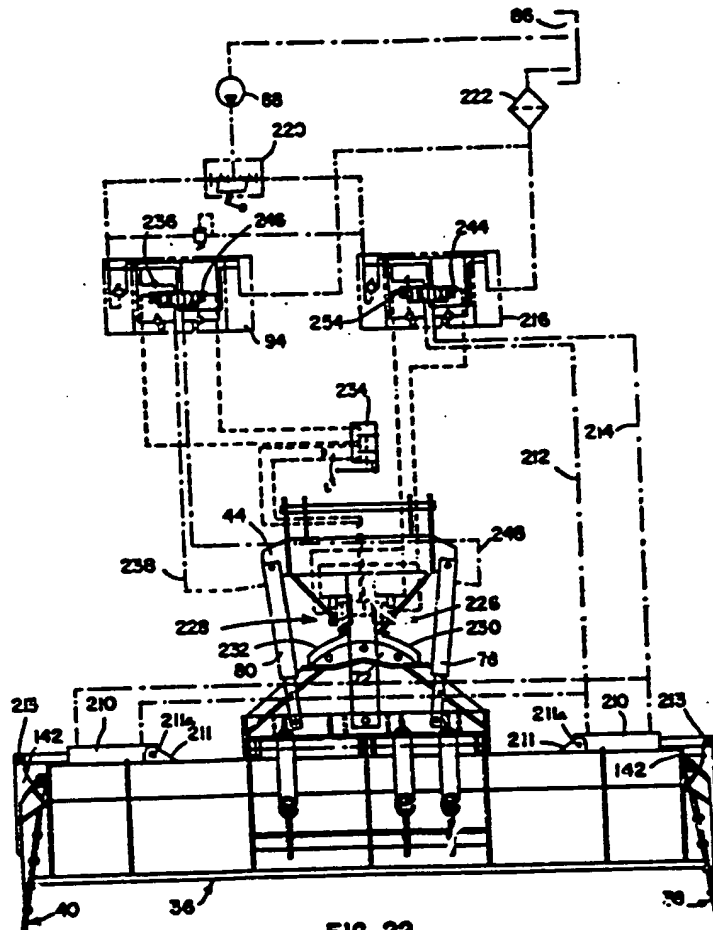


FIG. 22

Smith & Snyder

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10/4

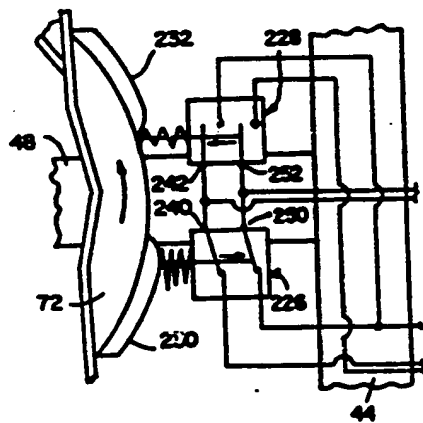


FIG. 24

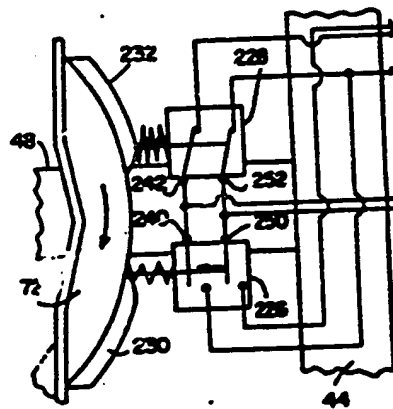


FIG. 25

Full 9 Size

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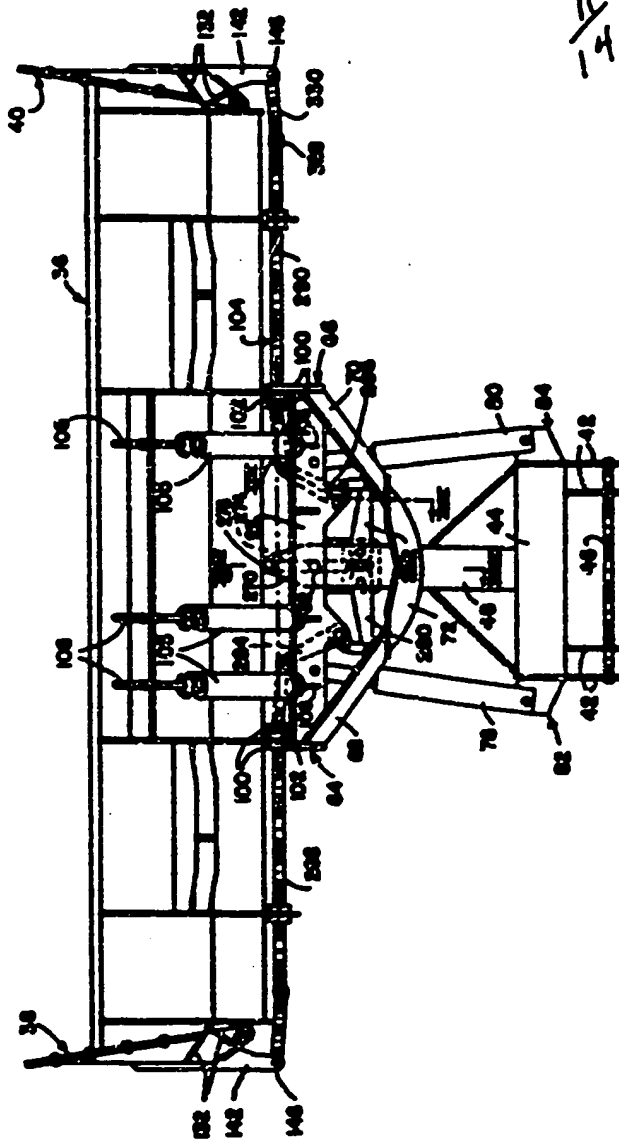
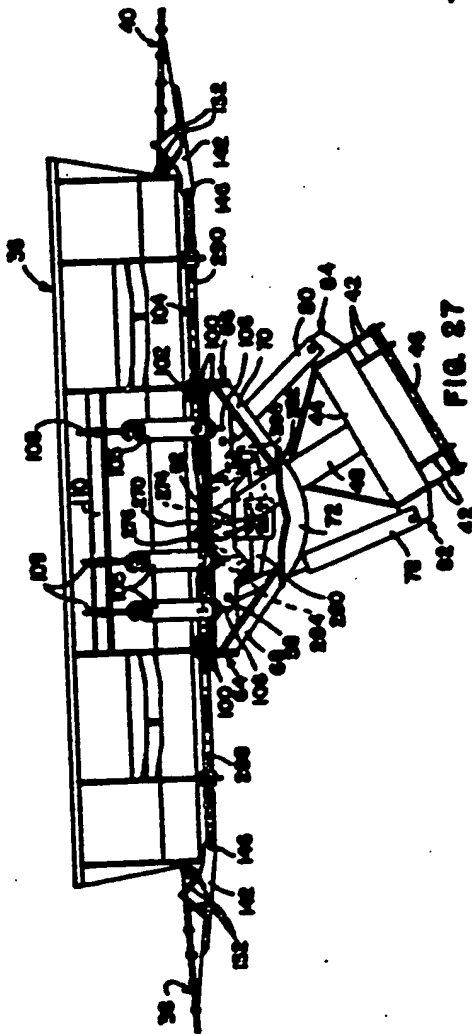


FIG. 26

Int. 3 Style

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End of Sheet

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13/14

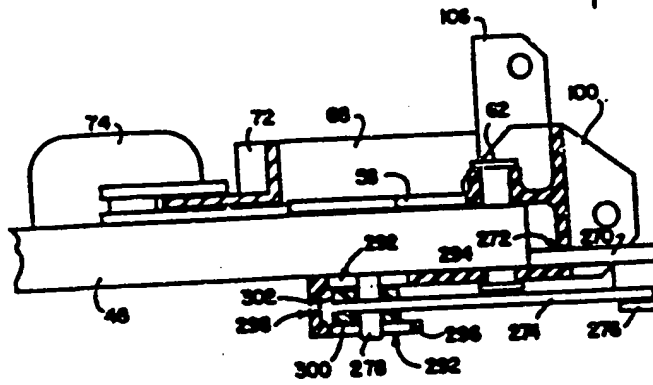


FIG. 28

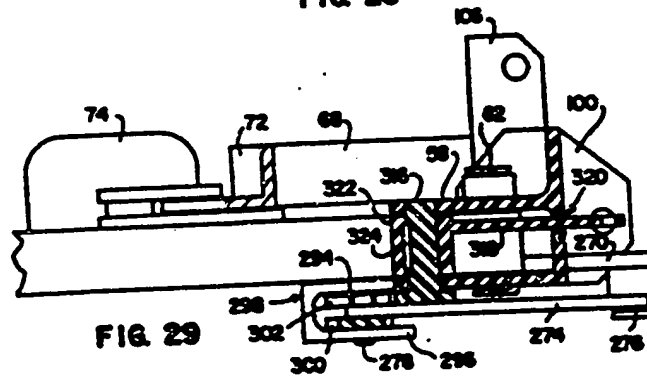


FIG. 29

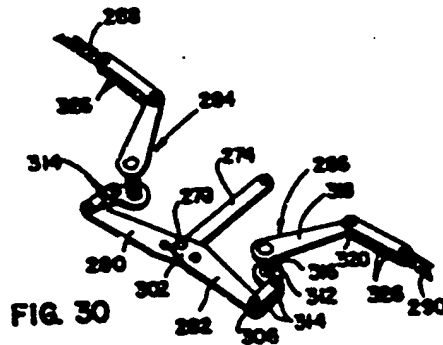


FIG. 30

End of Sheet

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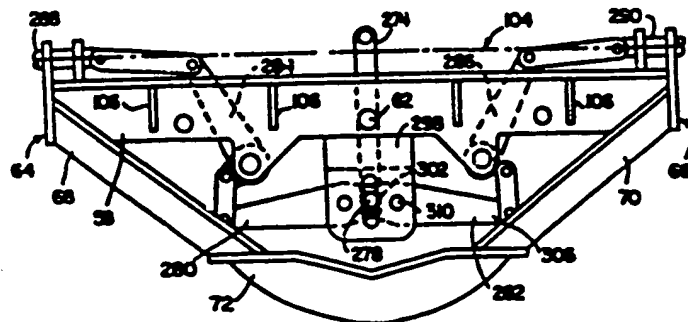


FIG. 31

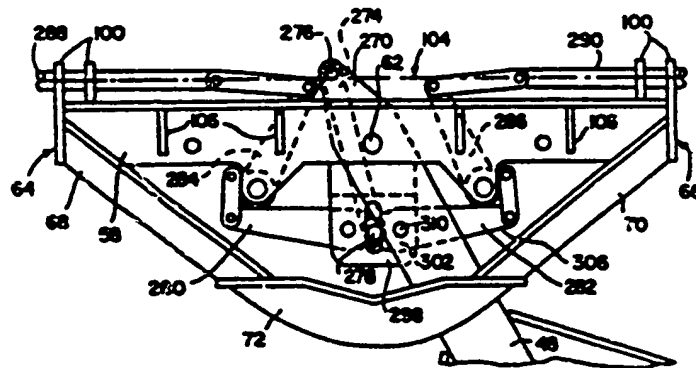


FIG. 32

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